IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	GREGORY, ET AL.
Serial No.:	10/825,658
Filing Date:	April 14, 2004
Title:	METHOD FOR MAKING A TERMINATION FOR A WIRE ROPE FOR MINING EQUIPMENT
Examiner:	Kuang Y. Lin
Group Art Unit:	1725

MAIL STOP AMENDMENT
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DECLARATION OF GEORGE GREGORY

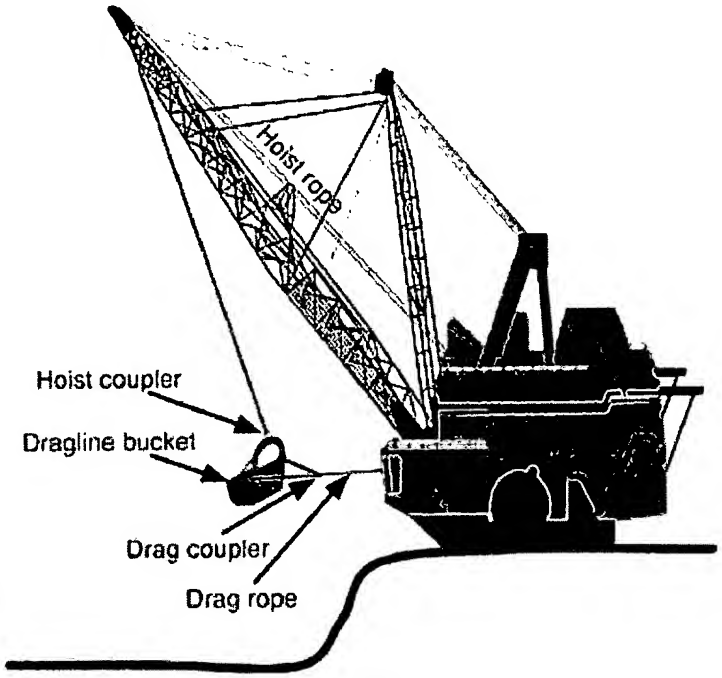
1. My name is George Gregory. I am the inventor of the invention disclosed in the above-noted application. I am over 21 years of age, of sound mind and willing and able to make the following Declaration.

2. I have been educated in the mining industry and worked in it for over 43 years. During that period of time in the industry, I have traveled to most of the major open pit mines in the world, including copper mines, gold mines and coal mines. I am the named inventor on several other patents, namely, U.S. Patent No. 5,343,641, U.S. Patent No. 5,321,902, U.S. Patent Application No. 11/016,940; U.S. Patent Application No. 11/107,636; U.S. Patent Application No. 11/472,605; PCT/US2004/043939 and PCT/US2006/014216. I consider myself a person of reasonable skill in the art of excavation mining equipment design.

3. I am familiar with dragline excavation systems and heavy equipment used in civil engineering and surface mining. These include most types of excavation cranes, drag lines and dump bucket subassemblies. I am also familiar with the mechanics of the crane itself, including the forces generated on its components during mining operations.

4. The larger types of dragline systems are used in open pit mining operations to extract cores of various metal and coal. The weight of these systems is in the vicinity of between 200 metric tons and up to 13,000 metric tons.

5. Dragline excavation systems typically use a dragline bucket system consisting of a large bucket which is suspended from a boom or large truss structure as shown below.



6. The bucket is maneuvered by ropes and chains. The hoist rope, powered by a large diesel or electric motor supports the bucket and hoist coupler assembly from the boom. The dragline is used to draw the bucket assembly horizontally. By skillfully maneuvering the hoist and the drag ropes, the bucket is controlled for various operations.

7. In a typical cycle of excavation, the bucket is positioned above the material to be excavated. The bucket is then lowered and a drag rope is drawn so that the bucket is dragged along the surface of the material. The bucket is then lifted using the hoist rope. A swing operation is then performed to move the bucket to the place where the material is to be dumped. The drag rope is then released, causing the bucket to tilt and empty. Filling and emptying the bucket is called the " Dig cycle"

8. The large dragline system used in a typical open pit mining situation costs approximately 50 to 150 million United States dollars. Downtime for large dragline systems can range between $5,000.00 and $12,000.00 per hour as a cost incurred to the mine for maintenance of the system.

9. A typical dragline bucket has a volume ranging between 30 and 90 cubic meters, although extremely large buckets have ranged up to 168 meters. The length of the boom ranges from 45 to 140 meters. In a single cycle, a large dragline system can move up to 270 metric tons of material.

10. Typical dragline systems consume huge amounts of power. They are connected to an electrical high voltage grid at 25 kilovolts.

11. Among the mines I have visited include Peak Downs in Queensland, Australia, Guernsey County, Ohio and others including most if not all of the open pit mines in the US. , Australia and South Africa.

12. The forces generated on the hoist rope, hoist coupler, drag coupler and drag rope can be immense. For example, it has been determined that the force on a drag rope can reach 1.4 million pounds in approximately two seconds during a drag operation. This immense pressure creates astonishing forces in the drag coupler and all other connection points on the dragline bucket. As another example, the hoist rope suspending the hoist coupler and dragline bucket necessarily can carry a tension of up to 450 to 500 metric tons, generating approximately 75,000 PSI in a four-inch rope.

13. I am familiar with the prior art used for coupling dragline buckets to both the hoist rope and the drag rope in the prior art.

14. A typical drag rope coupler is shown in Unites States Patent 4,602,891 to *McBride*. *McBride* shows an open wedge socket for a cable that includes a wedge having a peripheral surface for engaging the cable, a housing including an outwardly opening channel for receiving the wedge and cable and an interference member having a sliding fit on the housing to capture the wedge and the cable in the channel. Views 1 and 2 of that patent show the wedge sockets that typically force the wire rope to "loop around" a central wedge. The force exerted on the wire rope forces the loop and the wedge to pull against itself and become tighter as additional forces are applied.

15. One serious problem with this type of "loop around" wedge connector in the excavation mining industry is that the forces involved in open pit mining are so great that the wedge and "loop around" become locked in place, requiring jackhammers, sledge hammers and other impact devices to be used to dislodge the rope from the open wedge socket. The process is time consuming and therefore expensive. Moreover, safety improved by not having stored energy in the bent wire rope that the old method of the wedge system. When wedges were dislodged, shrapnel and flying debris can cause serious injury, therefore, the process can be dangerous.

16. The danger of using the old style wedge connectors in excavation mining has created a long felt but unsatisfied need in the industry. Before my invention, other attempts to remedy the problem consisted of lubricating the wedge, conditioning or cleaning the wire rope before insertion into the wedge connector and use of more powerful jackhammers to dislodge the wedge. None of these solutions worked satisfactorily because the actual connector design stayed the same. The design of my invention, including the claimed elements of the fused metallic termination (and the process for making it in the field) in combination with the frustroconical seat of my connector for use with wire ropes of 4 to 7 inches in diameter and with a connector weight of between 1500 and 2,800 lbs., solved these problems. It solved the problems because it allowed a far easier release of the wire rope than the prior art and could be used without lubrication and without hydraulic impact equipment.

17. In the creation of my invention, we were presented with other problems that were long-standing in the industry, but unresolved.

18. From time to time, the drag ropes and hoist ropes wear out and need to be replaced. The time to resocket the drag couplers and hoist couplers in the prior art was several hours due to the need to break apart the various pieces of the connectors to be removed.

19. For example, the down time to replace one coupler needed to be reduced because it was so expensive. Another example is that the tendency of the prior art couplers to "lock" and therefore require jackhammering needed to be eliminated. Another problem was that there was no testing equipment available that was large enough or powerful enough to test new coupler designs. This is because the process pressures and tensions involved in open pit mining are so large that no testing equipment was available in the world.

20. Because of the lack of testing equipment and the extreme expense of downtime, the industry was very hesitant to try anything new. Of course, if the new couplers failed quickly, the downtime would be drastically increased, thereby drastically increasing the cost of their replacement.

21. For these reasons, the industry did not desire to change from the prior art couplers such as that shown in *McBride* because they were known quantities and were reliable, if not awkward, expensive and dangerous to use.

22. There was great hesitation to use my invention in the industry. In fact, there was skepticism from many industry experts. First, there was no expectation that a molten metal capable of withstanding the process pressures could be made in the field quickly, because molten metal sources typically require a foundry and large ovens to produce. Second, there was a great hesitation to try my invention and skepticism of its potential success because various experts, mining operators and mining consultants believed that the wire rope would simply "pull out" of the termination under load.

23. Generally, I believe that most industry experts thought that it would not be possible to combine a portable source of molten material with the termination geometry that would supply a termination nugget that would withstand the large process pressures required.

24. There was great surprise in the industry when the method of my invention was successful. In fact, it has been so successful that the termination is stronger than the wire rope itself. Furthermore, my invention has also been surprisingly commercially successful. Despite the initial resistance to change, our connector and termination nugget process has been adopted and is being used successfully in open pit mines, including Alcoa, Arch, Peabody and Two mines in AU. Moreover, the invention has been successful in achieving its goals of reducing the time required in changing the coupler and drastically reducing the time it takes to do so. Downtime has been reduced from the prior art standard of approximately 6 hours to approximately 45 minutes using my invention. The results will contribute to a huge savings over the lifetime use of the coupler.

25. There has been no connector utilizing a fused termination and open socket connector such as my invention used in the open pit industry as far as I am aware. Moreover, the process of putting a molten metal termination on the end of a large diameter wire rope through burning of metal and metal oxide chips has never been used in the open pit mining industry before.

26. The success of the invention are both due to the claimed features of the invention as set out in claim 1 and claim 14 (as they have been amended most recently) including typically providing a socket weighing between 1500 lbs. and 2800 lbs., having a slotted opening parallel to the axis of the dragline and using the termination formed by my process on a dragline between 4 and 7 inches in diameter. The other elements of claims 1 and 14 were also instrumental in the success of the invention including the use of a mold and exothermic metallic material and connection of the connector to a mining excavation bucket.

27. I have carefully reviewed the prior art cited by the Patent Office in reference to my patent application. In my opinion, the prior art cited would not have been combined or recognized by one of reasonable skill in the art at the time the invention was made to arrive at my invention; for example, United States Patent 5,211,500 to *Takaki*. The invention of *Takaki* would not be used in the mining industry or recognized by those in the mining industry as a possibility to be used. The primary reason is that the *Takaki* patent deals with fiber ropes which are lightweight and corrosion resistant. In fact, the patent talks about composite ropes having excellent physical and chemical properties and being used in place of a steel wire rope at col. 1, lns. 35-38. The patent points out that a termination can be made on the end of a composite rope of an outer diameter of 7.5 millimeters. This is pointed out at col. 4, lns. 60-63. A composite rope of 7.5 millimeters would not be thought of in the mining industry where steel drag ropes can range between 4 and 7 inches in diameter and be made of thousands of steel strands. As a person of reasonable skill in the excavation mining industry, it is my opinion and I believe a reasonable opinion of others like myself that the two simply are vastly different in form, function and perceived usefulness.

28. The composite rope is also shown to be very lightweight in col. 5, lns. 55-56. Here, the breaking loads of the composite rope are said to be 5.8 tons (11,000 pounds) and the breaking forces in the mining industry can exceed 1,000,000 pounds. Additionally, the size of the terminations formed by the wire rope is extremely small. At col. 7, lns. 9-11, *Takaki* points out that diameter of the termination is between 30 and 60 millimeters. These sizes are so small that they would not be considered by someone of reasonable skill on the art in solving problems related to coupling drag ropes to drag chains in the open pit mining industry.

29. The steps of *Takaki* are also different because of the composite ropes. For example, at col. 6, lns. 33-37, after the termination is melted around the end of the composite rope, it is "cold pressed" onto the composite rope so as to be tightly and firmly connected. This step is necessary because the diameter of the composite rope shrinks as pressure is applied. If the termination were not "cold pressed" onto the composite rope, when pressure was applied to the composite rope, it would simply pull out of the termination. This step is not necessary in my invention because the steel rope is fused and welded to the termination because of the process temperatures involved and further the wire rope does not contract significantly upon application of process pressure.

30. The *Peeling* reference discloses a hot metal or resin type end fitting lubricated after application of the fitting to the strand by injecting lubricant through a thin tube extending between the wires of the strand. This application is used in a closed connector which surrounds the termination. The connectors of the *Peeling* patent are not used in the excavation mining industry because the terminations are not welded to the wire rope. Further, the size of the termination connector shown in Peeling is too small to be used in the excavation mining

industry. Further still, if the termination of the wire rope is lubricated in my opinion it would not work in the mining industry because the lubrication would facilitate the rope pulling out of the connector under the immense loads involved.

31. The *Mason* reference, United States 3,901,610 discloses and invention to be used with cranes. In this invention, the termination is cold pressed around the rope and has a single neck portion which is a peripheral depression. While convenient for cranes or fairly light loading, the process pressures in the mining industry are so much greater that cold pressing would not be effective and has not been used in the excavation mining industry as far as I am aware.

I declare under penalty of perjury that the foregoing is true and correct.

Date: 2/12/07

George Gregory